THE NATURE CONSERVANCY NEWS

September/October 1985

FLORIDA

Not everyone in Florida is a tourist.

Tom Blagden

Baby Alligator

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THE NATURE CONSERVANCY NEWS

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COVER: Wood stork—a long-legged wader that favors Florida's cypress swamps and seasonally flooded marshes. Nesting in colonies on or near the coast, the species is threatened in the state by rapid loss of habitat. Photo by Gary Meszaros.

The Nature Conservancy is a national conservation organization committed to the preservation of natural diversity by protecting lands and waters supporting the best examples of all elements of our natural world.

To date the Conservancy and its members have been responsible for the preservation of 2,457,339 acres of forests, marshes, prairies, mountains, deserts, and islands: home to rare and endangered species of wildlife and plants. 3,809 projects have been completed since the acquisition of the first preserve in 1954. Approximately 60% of all preserves are retained by the Conservancy and managed by staff and volunteer land stewards.

A membership organization, the Conservancy was incorporated in 1951 in the District of Columbia for scientific and educational purposes. The Nature Conservancy is a nonprofit, tax-exempt corporation under Section 501(c)(3) of the Internal Revenue Code and is a publicly supported organization as defined in Sections 170(b)(1)(vi) and 509(a). All contributions are tax deductible.

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The Nature Conservancy

A copy of the last financial report filed with the Department of State may be obtained by writing to: New York State, Department of State, Office of Charities Registration, Albany, New York 12231, *or* The Nature Conservancy, 1800 North Kent Street, Arlington, Virginia 22209.

C.C. Lockwood

Manatee and calf

Lynn M. Stone

American crocodile

Wesley F. Walden

Roseate spoonbill

President's Letter

IN FLORIDA, paradox is commonplace. Although it hosts America's oldest continuously inhabited city—St. Augustine, founded in 1565—Florida did not achieve statehood until 1845. There are no mountains to traverse and few (if any) punishing winters to weather. Yet the nation's railroad network did not reach Miami until 1896, almost three decades after the Golden Spike was driven at Promontory, Utah.

Its peninsular shape allows no inland site to be more than 60 miles from the sea. Still, most of the state's 11 million inhabitants are clustered in three coastal metropolitan areas. And while its growth is unparalleled—7,000 to 8,000 new residents arrive each *week*—Florida's natural diversity can be rivaled by only two or three others of the 50 states. It contains 288 natural communities and plant and animal species judged to be in danger of extinction by the Florida Natural Areas Inventory, a Conservancy-designed and operated natural heritage program.

This last paradox may be short-lived. Florida's great diversity is gravely threatened by its phenomenal rate of growth, which within the next 15 years will make it the state with the third largest population, following California and Texas. The resulting development pressures on the state's natural systems and habitats are of deep concern to The Nature Conservancy and its Florida members.

To determine which of the state's ecological elements are most jeopardized, the Conservancy relies heavily on the Florida Natural Areas Inventory. Now entering its fifth year under contract to the state, the program gathers data on the condition and location of disappearing Florida species and natural communities. It is the single most important source of information for the Conservancy, and for other conservation organizations, in establishing protection priorities. State agencies and private industries also depend greatly on this inventory data for determining their development and land management plans, for evaluating and acquiring land, and for generating environmental impact statements.

To date, through its highly motivated Florida Chapter, the Conservancy has completed 70 preservation projects that embrace more than 170,000 acres. A number of protection techniques were used to safeguard these areas, including our tried and true method of acquisition. One such acquired property is the Crystal River Manatee Sanctuary. More than 5,000 people contributed to the protection of this site, whose spring waters provide a warm refuge for the largest natural wintering concentration of this endangered marine mammal in North America. The 19 small islands surrounding the springs had been slated for construction of some 50 homes.

Through a current fund-raising effort, the Florida Chapter so far has collected $600,000 of the $900,000 needed to add 1,500 acres of critical lands to our 3,000-acre Tiger Creek Nature Preserve. A wetland and scrub complex in Central Florida, the refuge

encompasses nearly all of Tiger Creek's seven-mile watershed.

The chapter also received more than $2 million in private resources to purchase almost 4,400 acres for the globally significant Apalachicola Bluffs and Ravines Preserve (see page 13). Taking in three entire ravine systems, this premier sanctuary is one of the temperate world's richest paleorefugia (biological relicts of a past geological age). In addition, it offers spectacular vistas of the Apalachicola River and its bottomland hardwood forests.

Different views greet guests at Blowing Rocks, one of the chapter's oldest projects and the most visited area the Conservancy owns. On summer evenings, the beach here draws high concentrations of nesting sea turtles—especially loggerheads. Winter finds one of Florida's largest manatee herds grazing in the grassbeds of Hobe Sound, adjacent to this mile-long barrier island preserve.

OUR FIRST RIVER PROJECT in Florida dates back to 1971 when we acquired the Cummer Sanctuary on the Suwannee River. Seven other Conservancy-protected sites totaling almost 36,000 acres now edge this river, and more projects are under way. (A year-long biological survey of the Suwannee—see page 18—guides our efforts here.) These successes include cooperative ventures with the Suwannee River Water Management District—which has proposed acquisition of the river's entire floodplain—and with the U.S. Fish and Wildlife Service. Funds for most of the Suwannee River acquisitions were made available by our Rivers of the Deep South Program, initiated in 1981 with a $15-million grant from the Richard King Mellon Foundation of Pittsburgh.

Working with the Northwest Florida Water Management District, the Conservancy also has protected 17,000 acres along a 17-mile stretch of the lower Escambia River. About half of this property was a gift—the other half a bargain sale—of the St. Regis Paper Company. The project launched the Conservancy's $55-million-plus National Wetlands Conservation Project, made possible by another start-up grant ($25 million) from the Richard King Mellon Foundation. It also marked the district's first acquisition under Florida's innovative Save Our Rivers program and established a continuing partnership between the Conservancy and that agency—one of five regional water management districts in the state empowered to purchase riparian lands for conservation. Over the past six years, the Conservancy has completed 18 conservation projects encompassing 53,000 acres in cooperation with the state and its water management districts.

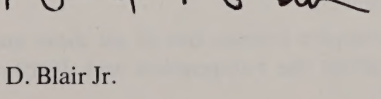
Developed in early 1981 by the Florida legislature—in response to Governor Bob Graham's request for statewide acquisition of "water-management lands"—the Save Our Rivers program is an outstanding resource management success story. It was strengthened significantly this past June when the legislature passed a bill to increase the state's documentary stamp tax fee, the source of the program's funds. It is estimated that the increase will generate, over a 40-year period, $750 million for the Save Our Rivers effort.

Protection of the 28,000-acre Seminole Ranch, which lines 19 miles of the St. Johns River, was a first step towards establishing the Save Our Rivers program. The ranch was jointly acquired in 1981 by the St. Johns River Water Management District and The Nature Conservancy, through its Rivers of the Deep South program. The event also was a major milestone in the district's revolutionary plan to restore the river's headwaters and upper basin.

Registry or "landowner contact" programs are another form of cooperative land protection, one which honors citizens who have agreed to safeguard ecologically valuable areas in their ownership. This fall, the Conservancy will initiate such a natural lands registry in Florida. Using information provided by the Florida Natural Areas Inventory, registry program staff will inform the owners of the state's 100 most important unprotected natural sites of their properties' ecological significance and ask for their cooperation in sustaining them. Given the success of similar programs in 16 other states, we expect to make great gains through this new voluntary protection effort.

WHILE A CURSORY look indicates that much has been done to save Florida's extraordinary biological diversity, the state's heritage program tells us that a great deal remains to be done. The task of the Conservancy and its Florida members is to outrace the state's rapidly growing population and its accompanying rate of development. But substantial resources now are available, land conservation programs are in place, and—most important—a grand spirit of cooperation is evident.

The challenge in Florida is great, but the opportunity is even greater. Yesterday's Florida can still be found; but without protection, it will soon disappear. As John Muir noted, following an 1867 trek through the state's then-wild and vine-entangled interior: "The universe would be incomplete without man; but it would also be incomplete without the smallest transmicroscopic creature that dwells beyond our conceitful eyes and knowledge."



William D. Blair Jr.

La Florida: The Land of Flowers

By Steve Gatewood and Dennis Hardin

WHY IS FLORIDA SPECIAL? The answer lies in its vast variety of natural communities and in the combination of physical factors (geology, climate, soils, hydrology . . .) that has formed and influenced the state's biological components.

The Florida peninsula is part of a limestone plateau that at no point is more than 326 feet above sea level. Over a long period of time, this low plateau has been uplifted, fractured, eroded, and alternately submerged and exposed by fluctuations in sea level. Advancing and receding shorelines also shaped and reshaped the land's surface. While most of north Florida and parts of the central ridge (which runs down the middle of the peninsula) emerged permanently from the sea several million years ago, south Florida and certain coastal sites have been "dry land" for less than 6,000 years. As a result, the biological communities of these areas are relatively young.

The state's climate ranges from temperate in the north to tropical in the extreme south. While geography is partly responsible for these variations, the sea that skirts the state on three sides also affects climate and weather. Just as the cold waters of the Pacific help keep coastal southern California cool and dry, the mild Gulf Stream maintains the warm and moist conditions of the Florida peninsula. Thus, climate and geographic position, coupled with a general warming trend during the past several thousand years, have favored subtropical species.

Composed predominantly of sand, with varying amounts of clay, shell, marl, and peat, Florida soils usually form a thin veneer over underlying limestone (although rock outcrops and thick hills of sand and clay are common). Rainfall is plentiful, 45 to 65 inches per year, but seasonal. As it percolates through the acidic sands, rainwater can dissolve the limestone beneath and create caverns with underground rivers. (Many of Florida's wetlands and lakes were formed when these caves collapsed.) The abundance of water—from the air, from beneath the ground, and from the surrounding sea—is another reason for the peninsula's luxuriant vegetation. This wealth of flora earned the state its Spanish name, La Florida—"the land of flowers."

The complex interactions of all these and other factors affect the composition and distribution of the state's natural communities. Although these communities are recognizable combinations of plants, animals, and physical conditions, their boundaries and differences are often obscure. Yet to save the rarest, we must first identify them. Very broadly, they fall into four categories: upland forests and hammocks; fire-maintained pinelands; wetlands and aquatic systems; and coastal areas and offshore communities.

THE UPLAND FORESTS of northern and central Florida are an extension of the classic southern mixed hardwood forest. Blanketing rolling hills of clay soils or limestone, they support a diverse mix of mostly deciduous hardwood trees, pines, shrubs, and vines. A typical individual stand may host American beech, southern magnolia, Florida maple, basswood, pignut hickory, spruce pine, loblolly pine, and white and laurel oaks with an understory of flowering dogwood, hop-hornbeam, sweetleaf, ironwood, wild azaleas, and American holly. Ground cover is usually sparse, but in certain upland stands it may contain such rare species as croomia and Florida torreya. These upland forests are not fire tolerant and must live more than 100 years to reach maturity. And, because they occupy rich soils, few high-quality examples remain.

Two of the rarest upland forest communities are slope forests and upland glades. The former grow on steep inclines where specific drainage features cause a rapid transition from extreme dryness at the top to wet, seeping conditions at the bottom. Although species typical of other upland forests are common, they are arranged in distinct horizontal bands: species needing the driest soils grade down to those needing the wettest. Ferns and other herbaceous plants are characteristic, especially on the lower part of the slopes. Exceedingly uncommon in Florida, upland glades are naturally occurring herb-dominated openings in forested areas. They occupy exposures of chalky limestone and support several species more often found on prairies in the Midwest.

HIGH PINELANDS on well-drained uplands, sandhill communities once covered extensive areas of the southern coastal plain. Remnants are

Major Florida Projects

THE NATURE CONSERVANCY

1. Apalachicola Bluffs and Ravines
2. Big Cypress Swamp
3. Big Shoals
4. Blowing Rocks
5. Choctawhatchee River
6. Corkscrew Swamp Sanctuary
7. Crocodile Lakes
8. Crystal River Manatee Sanctuary
9. Cummer Sanctuary
10. Deering Hammock
11. Dog Island
12. Escambia River
13. Hon. Theodore Roosevelt Preserve
14. Janet Butterfield Brooks Preserve
15. Kissimmee Prairie
16. Lignumvitae Key
17. Little Pine Island
18. Lower Suwannee NWR
19. Marianna Bat Cave
20. Ordway and Swisher Preserves
21. Peacock Springs
22. Perdido Key
23. Rookery Bay
24. St. Vincent's Island
25. Sanibel Island Projects
26. Seminole Ranch
27. Snipe Key
28. Spruce Creek
29. Tiger Creek Nature Preserve

Transferred properties
Conservancy-owned preserves

Joan Pennington

Doug Morrison

Wild Tiger Creek on Lake Wales Ridge slides through upland scrub and sandhills—two of Florida's threatened "high pinelands" communities. Celebrity species at the Conservancy's 4,500-acre Tiger Creek Preserve include the Florida scrub lizard (opposite, top) and the pygmy fringe tree (at right), both rare endemics with dwindling populations.

still widespread, largely in the Florida Panhandle, and some exist down the peninsula's central ridge nearly to Lake Okeechobee. But the best intact examples—those with an open canopy of longleaf pine and a dense ground cover of wiregrass—are rare. Frequent light spring and summer fires, about every two to five years, are essential to promoting the growth of wiregrass and a diversity of other grasses and wildflowers. Sandhills are the preferred habitat of the imperiled gopher tortoise and the host of "house guests" that depend on its burrow for permanent or temporary shelter (see "Ecology Forum," page 24).

Another high pineland community, scrub is dominated by sand pine, scrub oaks, rosemary, and deer moss. It occurs inland on sand dunes and ridges along former shorelines and on coastal sand dunes edging the Gulf and Atlantic Coasts. Inland scrub communities of the Ocala National Forest and Lake Wales Ridge, both north of Lake Okeechobee, flourish on white, fine-textured "sugar" sands that can become blazingly hot and dry. Like the sandhills, scrub is a fire-sustained community, though longer intervals (about 40 years) pass between the most severe conflagrations. These fires are so intense that they destroy the community's sand pines, stimulate the opening of their generally closed cones, and thus promote the establishment of a new forest from seedlings. Although hostile in appearance, the scrub community hosts an amazing assortment of endemic plants and animals that has attracted biologists and naturalists for more than a century. Beckner's lupine and pygmy fringe tree are among several such species under consideration for listing as endangered or threatened species by the U.S. Fish and Wildlife Service. Endemic animals of the Florida scrub include the scrub lizard, Florida scrub jay, and blue-tailed mole skink.

Fire also is important in maintaining the pine flatwoods that are found on flat, grey acidic sands. Few undisturbed examples of this ecosystem are left, as they have been largely replaced by slash pine plantations and other developments. A "hardpan" layer of soil one to four feet below the surface impedes soil drainage and, depending on its depth, dictates which of three types of flatwood communities will occur: scrubby, mesic, or wet. Often associated with the wet flatwoods in the Florida Panhandle, pine/cypress savannas harbor a large number of showy lilies, ground orchids, insectivorous plants, and endemic wildflowers—such as white birds-in-a-nest. Some of the

Doug Morrison

Doug Morrison

better examples occur in the Apalachicola National Forest and in the vicinity of Garcon Point near Pensacola.

FLORIDA IS ALMOST AS FAMOUS for its lakes, rivers, and wetlands as it is for sunshine and beaches. The state has more than 7,700 lakes greater than 10 acres in size. Most are in central Florida. Of these, Lake Okeechobee is the largest body of freshwater in the U.S. after the Great Lakes. Classified as a prairie lake, its greatest depth is only about 15 feet. The deep, clear sandhill lakes (a distinct natural community type) are fed by groundwater seepage. They are the most common lakes. The rarest are the coastal rockland lakes of south Florida and the dune lakes along the rest of the state's coastline.

A fascinating mix of lakes and river channels, the 250-mile St. Johns River is the country's longest northward-flowing river. It passes through more than a dozen major floodplain lakes on its course to the Atlantic Ocean. Like most Florida rivers, the St. Johns is a blackwater stream.

Related to these aquatic systems and occupying other lowlands throughout the state are millions of acres of swamps, marshes, and prairies. The most familiar are the floodplain swamps and bottomland forest communities of the major rivers. These largely deciduous forests are an integral part of the riverine system because they produce detritus that is annually flushed from the floodplain to fuel downstream communities. On higher parts of the north Florida floodplains, water oak, swamp chestnut oak, overcup oak, sweetgum, and green ash predominate. Lower areas are characterized by bald cypress, black gum, tupelo, water hickory, and water elm.

In central and south Florida, very few high floodplain flats exist because of the nonalluvial nature of streams. Thus, northern species are not apparent, and the floodplain forest communities here are dominated by cypress, black gum, diamondleaf oak, bays,

Lynn M. Stone

Elusive and endangered, the Florida panther roams south Florida's 62,000-acre Fakahatchee Strand—a portion of which is protected in a state preserve.

cabbage palm, and various tropical species. In the southcentral part of the peninsula, vast, treeless floodplain marshes are common along the rivers. They support maidencane, sawgrass, pickerel weed, and buttonbush—just a few of the many grasses, sedges, rushes, and shrubs that thrive in these wetlands.

In extremely flat areas throughout the state, there is often an absence of stream channels, and water flows in great sheets through broad, shallow strands and swales. Where fire is frequent and intense, herbaceous swale communities hold on. With less fire, the swales succeed to strand swamps. The grandest and most diverse strand is the Fakahatchee, at the western edge of the Big Cypress Swamp. Here, royal palms occur naturally with cypress, oaks, cabbage palms, and red maples. Most of the nation's remaining Florida panthers roam this 62,000-acre state preserve.

Within deeper, more protected parts of the Fakahatchee, pond apple slough communities host incredible profusions of bromeliads, orchids, ferns, and other plants requiring a warm, moist microhabitat. Sheltered from the freezes that would destroy them in a more exposed environment, 44 species of orchids grow in the sloughs. Of these species, 12 are found nowhere else in the U.S.

The prevalent natural communities of the Everglades and the Big Cypress Swamp, which stretch south of Lake Okeechobee, are wet prairies, marl prairies, basin marshes, and hydric hammocks. Sitting on one of the largest peat deposits in the world, the Everglades is a vast sawgrass, beakrush, and spikerush wetland. Willow heads and tree islands are common in the Everglades, while the Big Cypress is noted for its stunted "hatrack" cypress trees. Much of these two wetland systems has been altered by drainage, and they are now the focus of a state-proposed hydrological restoration plan (the "Save Our Everglades" initiative). More than 2.75 million acres are publicly owned and managed in the Everglades Conservation Areas, Everglades Water National Park, and the Big Cypress National Preserve.

Florida's other wetland communities include: cypress dome swamps, basin swamps, freshwater tidal swamps, bogs, and depression swamps. Of particular interest are the Panhandle's seepage slope communities, in which water percolating down through porous sand reaches an impermeable layer and leaks out on the side of a hill. If fires are frequent, open meadows develop on peat soils. Locally called pitcher-plant bogs (because four species of these insectivorous plants grow here), these communities also support sundews, butterworts, meadow beauties, and bladderworts. Less frequent fires result in dense thickets of titi—glossy leaved trees with fragrant white flowers.

FLORIDA'S COASTAL community types, both temperate and tropical, are perhaps the most imperiled. Scattered along the Gulf Coast are habitats for several rare species. Among these are Godfrey's blazing star and Gulf Coast lupine—both Panhandle endemics—and two of the most recent additions to the federal list of endangered and threatened species: Perdido Key beach mice and Choctawhatchee beach mice, endemic to the western Panhandle. In southern Florida's shoreline communities, beach jacquemontia on the east coast and Lakela's pinweed on the west top a long list of jeopardized species. The chief threat to most of these plants and

Doug Morrison

Railroad vine, making tracks on open sand. This tough pioneer has settled many a dune in the Sunshine State.

C.C. Lockwood

Mangrove "island"... Familiar along south Florida's shores, these tropical trees build bases for themselves from fallen leaves, sediments, and the marine organisms that attach to their roots.

animals is loss of habitat caused by beachfront development throughout the state and, in the south, by the invasion of such exotics as australian pine.

Along the beaches themselves, on the windblown ridges of sand just beyond the tideline, the beach dune community represents the "pioneer zone" of vegetation. Here, sea oats and railroad vine, along with other grasses and sprawling vines, establish themselves and stabilize the dunes by intercepting windblown sand and gathering it around their bases. Because of their abilities to sprout after burial, to root after fragmentation, and to produce relatively large floating seeds that can be carried by ocean currents, these tough pioneer species are well adapted to their environment of moving sand and salt spray.

A shrubby transitional natural community between the beach dunes and the inland maritime hammocks, coastal strands are characterized by saw palmetto, seagrape, scrub oaks, and cacti that take hold only after herbaceous plants stabilize the dunes. Windpruning, caused by drying winds and salt spray, often produces a smooth, dense canopy that looks much like a sheared hedge. Where a high, well-stabilized foredune is formed, the coastal strand shrub thicket often grades imperceptibly into maritime hammock communities on the sheltered leeward side. Although tropical trees occur in coastal communities at least as far north as Cape Canaveral and Tampa, the highly diverse tropical maritime hammocks—which support such trees as live oak, gumbo limbo, mastic, paradise tree, strangler fig, poisonwood, and a wide variety of tropical understory species—are found mainly south of Lake Okeechobee.

On coastlines where waves do not create sandy beaches, tidal swamp and marsh communities fill broad flat expanses between land and sea. Of these, the mangrove tidal swamps are restricted to central and south Florida shores—they're most abundant in the Ten Thousand Islands area and at the southern edge of the Everglades. Leaves and detritus from the red, black, and white mangroves are extremely important sources of energy for estuarine food chains. Where the growth of these tropical trees is suppressed by frost, tidal salt-marsh communities take over. Like the mangroves, the salt-marsh species of black needlerush, cordgrass, saltgrass, and glasswort produce nutrients that help sustain both marine life and many wading birds.

The coastal forest communities that have survived development on the eastern oceanside of the rocky Miami Ridge, which separates the Atlantic Ocean from the Everglades in Dade County, are called tropical maritime hammocks. On the other side of the Miami Ridge toward the Everglades, rockland hammock communities occur at sites that have been protected from fire (such as those near limestone

sinkholes). The dense, domed tree canopies of these hammocks fend off desiccating winds, frosts, and destructive hurricanes. The result is an interior microclimate that fosters the growth of an incredible diversity of tropical understory species and rare epiphytes and orchids.

In areas of the Miami Ridge that *are* exposed to fire, island-like pine rockland communities can still be found. Here, the underlying limestone is so dissected and solution-pitted that the ground surface is strikingly jagged. These "pinnacle rocks" harbor one of the rarest snakes in North America: the rim rock crowned snake. Dominated by south Florida slash pine, the pine rocklands also have shrubby tropical understories that boast an extraordinary number of endemic plant species. Of these, five recently have been federally listed as endangered or threatened, one of which—the crenulate lead plant—is known from only a single natural population at a county park in Coral Gables.

Fossilized coral reefs that were built up when sea levels were higher, the Florida Keys support tropical ecosystems unlike any others in the United States. Generally considered to be pine rockland or rockland hammock, the terrestrial communities of the Keys are nonetheless very distinct. The Keys pine rockland communities are noted for their understories of silver and brittle thatch palms. Although wild populations of these two species have been heavily collected, the state's new native plant law and propagation efforts by the Florida Native Plant Society will help protect remaining stands.

While tropical hammock communities of the upper Keys are tall, impressive forests of Jamaica dogwood, mahogany, gumbo limbo, and wild tamarind, those of the lower Keys are scrubbier and also include poisonwood and seagrape. Unique to the Keys, the rare cactus hammock communities bear an understory of unusual agave and cacti, such as the nationally endangered Key tree-cactus. Finally, the distinct but transitional coastal rock barren communities lie between the Key's rocky shorelines and their hammocks and pinelands. Here, salt spray, wind, and occasional storms produce open, rocky flats with stunted shrubs, succulents, halophytes, and sparse herbaceous vegetation.

Linda Duever

The rare "cactus hammock" community—little-known spectacle of the well-known Florida Keys.

WHETHER UPLAND OR COASTAL, aquatic or pineland, Florida's numerous natural communities are rich in flora and fauna. Perhaps 3,500 species of vascular plants and 900 species of nonmarine vertebrates exist in these ecosystems, and more than 10 percent are ranked by the Florida Natural Areas Inventory as special "elements" because their populations are few, limited in size, or threatened in some way.

Among the most significant species are the endemics—those found only in Florida. At least four regions of the state with particularly high numbers of endemic species have been identified: the Apalachicola River Basin, site of the Conservancy's Apalachicola Bluffs and Ravines Preserve; Dade County and the Keys, which support rapidly disappearing pine rockland and rockland hammock communities; Lake Wales Ridge, home for the Conservancy's Tiger Creek Preserve and various rare scrub communities; and the 1,200 miles of severely threatened Florida coastline—vulnerable habitat for a wealth of native species.

Although Florida's biological diversity is still high, there are no assurances that the very best or very last occurrences of many species or natural communities can be protected. Urbanization, recreational and coastal development, agriculture, mining, forestry, drainage, and the spread of exotic species are constantly encroaching on the very rarest. But the state, federal agencies, and The Nature Conservancy recognize the conservation challenge and are hard at work to meet it.

At the 1983 annual meeting of the Conservancy's Florida Chapter, Governor Bob Graham eloquently expressed this recognition: "We in Florida understand humanity's own vital stake in keeping wild things wild . . . for future generations and for our own sake as a species. For we have faced the reality that our wild beaches, our wetlands, our Everglades are fragile things—fragile things that unite the whole continuum of life, fragile things upon which not only panthers but also people depend in their common struggle to survive and prosper on this Earth."

Both working with the Conservancy's Florida Natural Areas Inventory, **Steve Gatewood** is the program's coordinator/community ecologist and **Dennis Hardin** is the botanist.

Doug Morrison

The Canyonlands of Florida

by D. Bruce Means

TURNING THE BIBLE on its head, E. E. Callaway, late resident of Liberty County, Florida, claimed that Adam and Eve were buried near his home town of Bristol—just a short way from the "garden" where they began. He wrote a book on the subject in 1971 and drew a small but serious following. Though his theory is lost in local history books, a glorious stretch of wilderness in the Florida Panhandle still bears the name he gave it.

The Garden of Eden, a 35-mile strip of bluffs and ravines along the Apalachicola River, may not be a pilgrimage site of the kind Callaway imagined—but it's a bright spot on the map for all of us who share the Conservancy's mission. With more plant and animal species than any other area of its size on the coastal plain from Virginia to Texas, and more rare and endangered species (111 by one count) and more endemics than any other area of its size in Florida, it's a full-fledged biotic treasure-house. And Apalachicola Bluffs and Ravines, as the Garden is now widely known, is one of the temperate world's richest paleorefugia—a site where ancient species, long gone from the surrounding landscape, continue to survive.

On a relief map, this ribbon of land immediately commands attention: in one quarter of a mile, it shows an elevational drop of 250 feet, a record for the state. And the area bears the state's longest exposed geological section, Alum Bluff—one of the Southeast's most significant fossil sites. It rises where a wandering bend of the river slams into its own eastern valley wall, keeping it freshly undercut and exposed by landslides.

Callaway wasn't the only person to be infatuated with the natural wonders of the region. Ever since the 1830s, when amateur naturalist Hardy Croom began sending plant specimens to his botanist friend John Torrey, a host of distinguished naturalists have puzzled over the area's strange mix of northern species, Florida endemics, and relicts of a bygone worldwide flora. Croom, a wealthy antebellum planter with a passion for botany, discovered the biological uniqueness of the Apalachicola ravines on trips between his plantations. Torrey honored Croom by naming a delicate wildflower (*Croomia pauciflora*), after its discoverer. Croom, in turn, saw to it that his friend and collaborator was likewise honored: *Torreya taxifolia,* a small evergreen found nowhere else on Earth, canonized Torrey's name.

D. Bruce Means

Bird's-eye view of Apalachicola's Alum Bluff— Florida's longest exposed geological section.

GHOSTS OF A FLORA that dominated the northern hemisphere for 20 million years—from North America across what is now the Bering Straits into Asia and Europe—the torreya, the croomia, and the Florida yew are star species at Apalachicola Bluffs and Ravines. (The Florida torreya may be even older than the others; it closely resembles fossil torreyas from southern Appalachia that date back about 100 million years—well into the age of the dinosaurs.) Isolated in relict populations by the emergence of new mountain ranges and the general cooling of climates over the past several million years, many of these northern hemisphere plants and animals show a fragmented geographic distribution. For this reason, America's Southeast is biologically more like eastern China than anywhere else. Interestingly, and mysteriously, the proportion of plants at Apalachicola Bluffs and Ravines with close relatives in eastern Asia is higher than most other places in the Southeast.

Another distinguishing feature of the flora at Apalachicola Bluffs and Ravines is the high proportion of northern species. Mountain laurel, wild ginger, wild hydrangea, bladdernut, trailing arbutus, baneberry, rattlesnake plantain, and others grow in the sheltered depths of the ravines, which simulate the mountain cove valleys of the southern Appalachians. All other rivers in Florida originate on the coastal plain, but the headwater streams of the Chattahoochee River (as the Apalachicola is called north of the Florida border) drain the south face of the Blue Ridge in northern Georgia. Deep stream valleys all along the Chattahoochee served as stepping stones for Appalachian plants and animals that have used the river as a highway for dispersal into the ravine system. No other river—not even the mighty Mississippi, which drains the whole interior of the continent—brings so many northern plants down near the sea.

Through the years, the Garden has been relatively unaffected by human encroachment thanks to its remoteness from the centers of Southeastern development. But the continuing population shift to the Sunbelt is changing all that. The nearby coast (from Panama City to St. Marks) is booming, and the repercussions can be felt all the way to the Apalachicola.

Florida's Torreya State Park, established in 1935, afforded protection to 1,063 acres of Apalachicola ravines. It was an early step in the right direction—but because that sanctuary lies above a major geologic break (an ancient shoreline), its boundaries did not capture a full spectrum of natural communities. Most importantly, the park left out the region's "steephead" ravines, uncanny landforms described for the first time here at the Garden of Eden.

The steephead creation story is complex and fascinating. For some five million years, the shoreline of the Gulf of Mexico stood three miles south of the state park, during which time vast quantities of sand were deposited along the ancient coast. When the sea receded about two million years ago, the old coastal sands were exposed to a peculiar type of erosion that continues today. Despite a copious 55 inches a year of rainfall, there is little surface erosion; the porous sands soak up the water like a sponge. But the rainfall stacks up in large reservoirs of perched groundwater *beneath* the sand—and where that water manages to make its way out along a slope, it seeps or even gushes, gradually carrying away the sand and undercutting the slope itself. Eventually, the seeping water creates a deep cul-de-sac in the landform.

Over long periods of time a steephead can cut back several miles, forming a long valley with lateral branches where secondary steepheads develop and migrate at right angles from the main valley. The ecology of these systems alone justifies protection of Apalachicola Bluffs and Ravines. Among the many singular features of steepheads, the fact that their streams vary only slightly from 68 degrees Fahrenheit at any season (buffering the environment both thermally and chemically) makes them a comfortable year-round habitat for scores of rare species.

FLORIDA CONSERVATIONISTS have worked for years to save the steephead lands along the Apalachicola River. In 1974, the Garden of Eden's

Sweetwater Creek was proposed to the Florida Department of Natural Resources' Environmentally Endangered Lands (EEL) Program; and later, Beaverdam Creek rose high on the state's Conservation and Recreation Lands list (successor to EEL). Despite this recognition of the area's significance, no conservation action occurred during the years that followed.

Even without formal protection, the steepheads seemed secure from development until 1981, when a key section of the wilderness was threatened. Seminole Electric Company targeted Alum Bluff as its number one choice for siting a 1200-megawatt coal-fired electric plant. Suddenly the valleys and their shadowy legions of living things were doomed. At a meeting in Tallahassee, scientists from the Conservancy's Florida Natural Areas Inventory (a heritage program similar to those designed by the Conservancy in most of our 50 states) met with Seminole officials and provided information on the singular ecological values of the site. Owing largely to their consideration of these facts, utility decision-makers chose another property in an adjacent county for the plant.

Even as the meeting took place, the Conservancy's Florida Field Office was negotiating with the landowner for acquisition of the property. By that time, Conservancy staff had been working with Floridian Elizabeth Ordway Dunn for nearly a year to identify sites through which she could, in her words, "do something important for land conservation in Florida." The 1,158-acre Alum Bluff tract and Mrs. Dunn's charity were a marriage made in heaven—or at least in the Garden of Eden. Her $1.2-million gift, the largest cash contribution ever made for conservation in Florida, ensured protection of some fine steepheads, dozens of important species, and Alum Bluff itself (see box, page 16). The Conservancy acquired the adjacent 3,214-acre Beaverdam Creek property from St. Joe Paper Company a year later (via a timber swap), adding fifty of the best steepheads to its new Apalachicola Bluffs and Ravines Preserve. Even today, the Conservancy is working to preserve inholdings and prime tracts contiguous to the sanctuary. The job is not yet done.

TO UNDERSTAND the allure of steepheads, you've got to imagine yourself entering one. You're starting out on a sandy plain of pine and scrub oak, but a dark band of foliage draws your eye—a phalanx of low evergreens. As you pass through it, you're astonished to find that the land under your feet is falling away into a deep, shady natural amphitheatre some 50 yards in diameter. From your position at the lip, you stare into a drop of about a

Larry Morse

Larry Morse

D. Bruce Means

A garden of "Eden" endemics: globally endangered Florida torreya (top) and croomia (above)—ghosts of an ice-age flora—and orange azalea (at right).

THE LEGACY OF ELIZABETH ORDWAY DUNN

In 1980 an anonymous gift of $1.2 million was made to the Conservancy's Florida Chapter for the purchase of Apalachicola Bluffs and Ravines. The donor, the late Elizabeth Ordway Dunn of Palm Beach, didn't stop there. She worked tirelessly with Conservancy staff and consultants to establish two special trusts that will fund conservation projects in the state for years to come.

The first provides $660,000 each year for 20 years for Conservancy land acquisition and stewardship efforts. (Already, the fund has enabled the Conservancy to make critical additions to Apalachicola Bluffs and Tiger Creek Preserve.) The second established The Elizabeth Ordway Dunn Foundation, which makes annual grants for land conservation and other environmental programs in the state. One of its early actions was to make a $50,000 challenge grant to the Conservancy for a Florida Natural Areas Registry, through which landowners will be encouraged to protect the natural values of their properties.

When Mrs. Dunn passed away in April of 1984, she left a conservation legacy that will grow into the next century. Her contribution is an inspiration to all who care about wild Florida.

hundred feet. Looking straight ahead, you see the treetops: magnolias, beech trees, hickories, oaks, sweetbay, and other hardwoods.

The sidewalls are so sheer you have to plant each foot with care as you progress, reaching for handholds. Because the slope drops at a very sharp angle (45 degrees or greater), you descend as much with each step as you advance—or more. Here along the upper third of the sidewall, you pass through a dry dwarf forest of oaks, hickories, and other scrubby hardwoods. You may see the Alabama spiny-pod or the Ashe's magnolia with its 12-inch flowers (both ranked nationally endangered by Conservancy scientists).

You have the sensation of climbing down a tree as you descend—until, on the lower half of the slope, you enter an entirely different vegetation type. A beech/magnolia forest (with spruce pine, American holly, dogwood, white oak, pignut hickory, and other deciduous trees) reaches skyward in apparently branchless columns. At the bottom of this zone, a dense evergreen shrub understory presents a nearly impenetrable wall of twisted and tangled stems. This is the haunt of many of Florida's rarest and most interesting plants. Appalachian mountain laurel and rhododendrons consort with shrubby hollies, vacciniums, and the area's two botanical gems—Florida yew and the Florida torreya tree. (The latter, a federally listed endangered species, has been pushed to the brink of extinction by those who early sought it for use as fenceposts and by a recent fungal blight.)

Crawling and twisting to make passage through the shrub zone, you reach the valley floor, where you are surrounded by hardwoods and shrubs that prefer permanently saturated (but not inundated) soil. The brook at your feet is something out of a dream: white sand and tiny quartz pebbles show through wide, thin sheets of perfectly clear water. Where does it come from? You turn to look at the toe of the steephead valley wall and find that the full stream emerges—all at once—from the sand at the base of the slope.

At the bottom, the humid air is thick with the sweet, pungent aroma of rotting star anise leaves. The low stream banks and sandy stream bed display a tapestry of hardwood leaves: tan, brown, black, and red in every season. And from these somber hues arises the new green of delicate mosses, liverworts, and ferns. You're not really alone here. If you sit quietly and study the litter for a few moments, a microcosm pops into view. The ground fairly dances with tiny amphipods, springtails, orthopterons, beetles, spiders, dipterons, earthworms, millipedes. . . .

Cary Meszaros

The remarkable gopher tortoise—hotelier of Florida sandhill country, including Apalachicola Bluffs. High on the reptile's long "guest register" is the nationally threatened eastern indigo snake (opposite.)

Gary Meszaros

DISCOVERY IS STILL the rule at Apalachicola Bluffs and Ravines. Despite the fame of some of its relict and endemic plants, the area has never been exhaustively surveyed. In 1982, naturalists Wilson Baker and Stephen Leonard, at the behest of the Conservancy's Florida Field Office, walked the ravine slopes from Bristol to Chattahoochee and discovered ten species new to the state and confirmed the occurrence of three others that hadn't been seen for nearly a century! And this is only one of many pioneering tales featuring a number of fine investigators.

Having spent 24 years exploring the area, I have discovery stories of my own. In the process of studying a group of salamanders on the coastal plain, I long ago recognized that the salamanders in the Apalachicola ravines were different from their cousins elsewhere. Only in recent months have we received conclusive evidence that the Garden's salamander is indeed a distinct species. We're working on a name.

Another case in point: when Harvard biologist E. O. Wilson asked on a visit a couple of years ago where we might go in north Florida to find something really different, I headed for the Garden of Eden. The results were dumbfounding. We'd been in the area less than three minutes and had walked only 30 yards from the car into a xeric hilltop hardwood forest when he shouted, "Look! It's a *Formica fusca!*" In that moment, Wilson, a trained entomologist, had added a new animal to the Florida list—extending the southern limits of an entire species group of northern ants 186 miles from the latitude of Tuscaloosa, Alabama, where he'd known it as a boy.

Even if you're not literally discovering, there's always a sense of discovery in this wilderness. On many an autumn day, I've sat expectantly on the crest of Alum Bluff to catch a glimpse of swallow-tailed kites sailing on thermals. And then I've scrabbled along the swampy bottoms of Beaverdam Creek, sleuthing out the dark creatures of the litter and the muck—sometimes lucky enough to spot the snout of a one-toed amphiuma (a kind of secretive salamander) as it gingerly breaks the surface for a breath. Later—tired out and wholly renewed— I've given E. E. Callaway's theory another look.

D. Bruce Means, president of the Coastal Plains Institute of Tallahassee, Florida, teaches biology at Florida State University. Having recently retraced John Muir's 1,000-mile walk from Kentucky to the Gulf of Mexico, Means is writing a book on the experience.

"The Garden of Eden"—a Conservancy film that was nominated for an Academy Award in 1984—can be rented from Direct Cinema, P.O. Box 69589, Los Angeles, CA 90069.

A Journey Down the Suwannee

By J. Merrill Lynch

EMERGING FROM the vast wilderness of the Okefenokee Swamp in southeastern Georgia, the Suwannee River starts its 240-mile journey south through northern Florida toward its final destination in the Gulf of Mexico. From a rather ordinary beginning as a southern blackwater river, where cypress-lined shores tower over slow-moving currents, the Suwannee gradually transforms into three different rivers as it wends its way south.

A combination of geological, topographical, and geographical factors—along with perhaps an element of chance—has protected much of the river, its floodplain, and its flora and fauna from most of the effects of overpopulation, pollution, and habitat destruction. It runs through a region in which most of the land is still rural, towns with more than 2,000 residents are considered large, and life rolls along as slowly as the river.

As the Suwannee issues from the Okefenokee, its waters are colored by the humic and tannic acids of the swamp's decaying vegetation. For the next 60 miles or so, the fabled stream flows through what is known as the northern highlands physiographic region—an area of extensive flatwoods called piney woods by the locals or pine flatwoods by community ecologists. These native flatwoods occur in association with strands of cypress and tupelo swamps in a poorly drained, perennially wet landscape. (The water table is often at or very near the surface.) Because of the wet, acidic soils, farms are few, and the region is not heavily populated. Most of the land remains wooded although, in recent years, large timber corporations have acquired and converted much of the flatwoods to slash pine tree farms or plantations. Here, the Suwannee is confined to a fairly narrow floodplain dominated by bald cypress and Ogeechee tupelo swamps—along the stream banks and in the low areas—and by a mixture of live oaks, laurel oaks, and slash and loblolly pines in the higher areas. Sharp-leaved saw palmettos, shrubby relatives of cabbage palms, form almost impenetrable thickets in the floodplain. Like the surrounding soils, the river's waters are very acidic, and fish and invertebrate species are relatively scarce.

Near the town of White Springs, the character of the Suwannee begins to change. After meandering through flat, sandy lands, the stream suddenly encounters beds of resistant limestone at Big Shoals. The dark, placid waters are frothed and churned into white-water rapids and standing waves by these outcrops, which cut perpendicularly across the river. The largest of only a few stretches of whitewater in the State of Florida, Big Shoals and several sets of smaller rapids attract thousands of canoeists and kayakers every year.

The Nature Conservancy has been active in protecting the Suwannee's Big Shoals area, along with

John Hall

Swath of sun and mist, Suwannee River.

the site's various plant and animal communities. In 1984, thanks to the generosity of the Richard King Mellon Foundation and the James Graham Brown Foundation, the Conservancy purchased 3,263 acres next to the shoals. Known as the Brown tract, the property encompasses a five-mile stretch of the river and at least ten distinct natural communities. Its mesic longleaf pine flatwoods are home to a large population of gopher tortoise—a species under review for federal protection (see page 24)—and the seepage slopes support the rare and local needle palm. The site also hosts the Suwannee cooter, a turtle of special concern in the state. And there's more: black bears, wild turkeys, Mississippi kites, river otters, and beavers, as well as a rookery harboring nesting pairs of American anhingas, great egrets, great blue herons, and cattle egrets.

A number of state agencies are cooperating with the Conservancy to preserve the Brown tract. While the floodplain portion of the area has been transferred to the Suwannee River Water Management District, the rest of the property is expected to be conveyed to the Florida Department of Natural Resources and jointly managed by several state agencies.

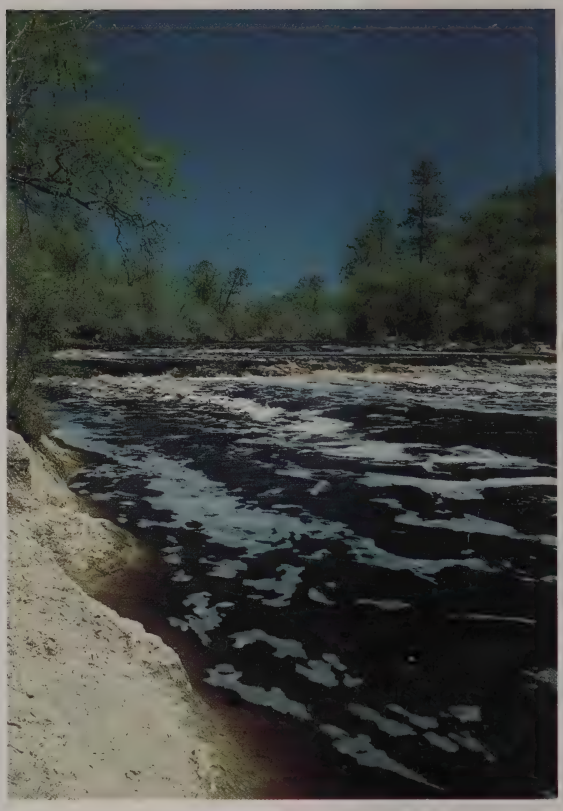
In addition, the Conservancy is currently working to safeguard more lands both upstream and downstream from the Brown Tract. Its aim is to connect a corridor of wetlands and adjacent uplands along the river that will provide scenic and ecological buffers to the Suwannee system. Many protection methods are being used, including purchases, conservation easements, land trades, and donations of property.

Downstream from White Springs, the river begins its descent across the rolling hills of the Cody Scarp,

an ancient shoreline formed by a Pleistocene sea. The scarp marks the transition from the northern highlands to the Gulf coastal plain, two distinct physiographic regions. For about the next 40 miles, the Suwannee's banks are steep—as high as 50 feet—and covered by huge, moss-covered live oaks, southern magnolias, and pignut hickories. The trees shade fern-covered outcroppings of fossil-rich limestone. Bridges, houses, and other buildings are infrequent.

OF ALL THE NATURAL phenomena found along the Suwannee, the stream's freshwater springs are among the most remarkable. Between White Springs and Manatee Springs to the south—a distance of over 140 miles—the Suwannee River floodplain boasts at least 53 springs, including six "first-magnitude springs" (those having a discharge rate of 65 million gallons per day). Another 50 occur along the Suwannee's three major tributaries: the Santa Fe, the Withlacoochee, and the Alapaha. All told, the region embraces Florida's highest concentration of artesian springs. The most spectacular lie at the bottom of clear deep blue pools rimmed by limestone walls and surrounded by live oak hammocks.

These spring basins range in size from a few feet to 100 feet or more across and are often 30 to 40 feet deep. From crevices in the basins' bottoms and in



J. Merrill Lynch

John Hall

Top: at Big Shoals, the Suwannee roils over resistant limestone outcrops that cut across its course. Generous support from the Richard King Mellon and James Graham Brown Foundations enabled the Conservancy to save 3,300 shoal-side acres last year. Above: a river otter casts off Suwannee waters.

the rock walls, the artesian waters often spurt out with such force that the surfaces of the pools appear to be boiling. Waters that "boil over" flow down narrow spring runs before emptying into the Suwannee.

Although a few of the spring systems in the Suwannee River Valley are protected in state parks, most are privately owned and have been affected by varying degrees of overuse and development. When the Conservancy's Florida Chapter, late last year, purchased 240 acres to safeguard the main springs of Peacock Springs, it was a major coup for the organization.

One of the finest remaining spring systems in the valley, the recently acquired site is well known for both its geology and ecology. Its underwater cave system—a limestone labyrinth with a year-round temperature of 72 degrees—is the most extensive one known in Florida, as well as one of the longest underwater caverns in the continental United States. More than 28,000 feet of passages have been explored and surveyed. Both the springs and the cave system harbor at least three crustaceans endemic to Florida's limestone regions: pallid cave crayfish, Hobb's cave amphipod, and Florida cave amphipod. (The amphipods are candidates for federal listing.) The spring run is aso habitat for two other animals native to the Suwannee River region—the Suwannee cooter and the Suwannee bass—and the site's rolling terrain supports four major natural communities.

The Nature Conservancy is working on an agreement to transfer the property to the Florida Department of Natural Resources as an addition to the state park system. It also hopes to expand the sanctuary so that it will include bufferlands both upstream from the spring system and downstream along Peacock Slough, the major spring run that drains Peacock Springs.

AS THE RIVER is fed more and more by large artesian springs, the acidic black waters are diluted. (During periods of low flow, up to 60 percent of the Suwannee's volume is supplied by these springs.) Here, below White Springs, the river also is joined by its three major tributaries. Because the Alapaha and Withlacoochee drain Georgia claylands, they add, during high flow, a new ingredient to the Suwannee—sediment. The river's spring-diluted waters change to a murky brown, turbid with suspended silts and clays.

The Suwannee now has undergone its last transformation: in its final 70-or-so-mile run to the Gulf, it is an alluvial system of brown waters, more characteristic of rivers draining the Piedmont Region of the South. Its floodplain broadens considerably and the channel widens. Extensive swamp and bottomland forests appear. Vestiges of its past exist as old, silt-filled oxbow lakes—former channels long since abandoned by the constantly meandering river. The sediment alters not only the stream's appearance but its chemical and ecological makeup as well. Higher nutrient levels mean a greater diversity and abundance of species. In other words, the fishing is much better.

Frequent spring floods carry the nutrient-rich waters out across the low, broad floodplain, where its sediments are deposited in quiet backswamps and cypress sloughs. The depth, duration, and frequency of flooding determine the nature of the region's plant communities. For example, bottomland hardwoods—characterized by live and laurel oaks, water hickory, sweetgum, and sugarberry—occur on the slightly better-drained flats and levees, while wetter flats and sloughs are dominated by swamp forests of bald cy-

J. Merrill Lynch

Florida's most extensive underwater cave system—a limestone labyrinth called Peacock Springs—is a new Conservancy project on the Suwannee River floodplain.

press, water and swamp tupelo, and overcup oak. These forests host a large breeding population of swallow-tailed and Mississippi kites, nesting colonies of white ibis, cattle egrets, little blue herons, yellow-crowned night herons, and American anhingas—and such mammals as river otter and bobcat.

Currently, the Suwannee River Water Management District is purchasing more than 1,100 acres of bottomland and swamp forest identified by the Conservancy as a high priority site. A generous bargain sale was negotiated with the owners, Priscilla Ziesse and Owen Baynard, who wished to see the land protected. The property supports some of the largest stands of old-growth timber remaining along the lower portion of the river. In addition, it claims an exceptionally large population of cedar elm, a tree endangered in Florida and known to exist only in scattered populations along the state's Suwannee and Crystal Rivers. The species is disjunct from its nearest verified populations in the Mississippi River Valley—over 500 miles away.

Gerard Lemmo

White ibis, one of several colonial nesting birds that live along the Lower Suwannee.

John Hall

Cypress slough, Suwannee River. In its long run from Okefenokee Swamp to the Gulf, this legendary watercourse ranges from slow black stream to frothing sluice to the wide channels of an alluvial system.

Farther downstream, near the town of Fannin Springs, lies one of Florida's grandest stretches of high-quality hardwood hammock forest. The Andrews tract fronts on the river for more than four miles and takes in 3,800 acres of predominantly upland hammock. It also features two national and four state champion trees and one of the state's densest wildlife populations.

Maintained over the years as a private hunting and fishing reserve, the Andrews tract was imminently threatened by subdivision developers. The Conservancy moved quickly to negotiate with the landowners, who are eager to see their land preserved. A 938-acre parcel was acquired and recently transferred to the Florida Department of Natural Resources for inclusion in the state's park system. The remaining acreage is being purchased by that agency.

AT THE SUWANNEE'S final destination in the Gulf of Mexico, the river's mouth is surrounded by a variety of natural communities. Numerous tidal creeks thread through extensive brackish and salt marshes—marshes that provide habitat for a number of rare and endangered species, such as brown pelicans, wood storks, and bald eagles. Scattered throughout the marshes are islands of cabbage palmetto and red cedar trees. Many of the tiny isles actually are old Indian middens, piles of oyster shells formed by past generations of native Americans while eating at their traditional campsites.

Occupying the floodplain just upstream are huge swamp forests characterized by bald cypress and water tupelo—home for many wildlife species, including an occasional rare black bear. Sightings of the critically imperiled Florida panther also have been

Buckeye Cellulose Corp.

A sweeping view of the Conservancy's latest addition to Lower Suwannee National Wildlife Refuge: some 13,000 wetland acres gained through a bargain sale from Buckeye Cellulose Corporation.

reported, though not confirmed. In and around the Suwannee's mouth, Florida (or West Indian) manatees browse on the submerged grassbeds during summer months. Many of these same manatees winter near the Conservancy-protected islands of King's Bay in the Crystal River to the south.

Conservancy efforts to protect the mouth of the Suwannee began in 1971 when the Cummer Company donated a three-and-a-half-mile stretch of land along the river. Called the Cummer Sanctuary, the site embraces 985 acres of rich swamp forest. It is owned and managed by the Conservancy's Florida chapter.

Through a more recent and particularly significant transaction, the Buckeye Cellulose Corporation (a subsidiary of the Procter and Gamble Company) made a bargain sale to the Conservancy of 12,836 acres near the Suwannee's mouth. The property includes an especially scenic sweep of the river, which Buckeye Cellulose had maintained for years as a preserve. This acquisition brought Conservancy-protected land within the 51,926-acre Lower Suwannee River National Wildlife Refuge to 31,006 acres. Created through the cooperative efforts of the U.S. Fish and Wildlife Service, the Suwannee River Water Management District, and the Conservancy, the immense refuge encompasses tidal salt marches, floodplain forests, hydric hammocks, mesic flatwoods, and some 21 miles of the river's lower channel.

FROM ITS HEADWATERS in the Okefenokee Swamp to its mouth in the Gulf of Mexico, the Suwannee River is one of the nation's least disturbed and richest aquatic systems. The Nature Conservancy views the entire river as a single set of interconnected and interdependent ecosystems. Consequently, it has developed a unified approach to protecting the stream's overall biological diversity by safeguarding its most ecologically significant species, spring systems, and natural communities. Integral to this goal is the ongoing effort to work closely with landowners, corporations, and federal and state agencies. Such partnerships are essential to saving Florida's fabled Suwannee.

Working out of the Conservancy's Southeast Regional Office, **J. Merrill Lynch** is the field ecologist/protection planner for the Rivers of the Deep South Program. He spent a year on the Suwannee studying the river's varied natural communities and ecosystems.

ECOLOGY FORUM

No. 56
by Dale R. Jackson
Zoologist, Florida Natural Areas Inventory

FLORIDA'S "DESERT" TORTOISE

Many have noted that in our society, the search for the perfect host is as futile as the search for the perfect guest. The relationship is often strained, occasionally hostile. But shift the focus to the animal kingdom and the picture changes. Here in Florida, without too much trouble, we find the gopher tortoise *(Gopherus polyphemus)*—a creature whose home provides shelter for an assortment of life forms rivaling the Ark's passenger list.

In contrast to its better-known relatives on Ecuador's Galapagos Islands, the gopher tortoise has developed neither the diversity of body forms nor the gigantic size that captivated Charles Darwin's imagination and won the admiration of the entire world. With a plain brown shell, a seemingly mismatched set of legs, and a face not unlike that of "ET," it won't win any beauty contests. But there *is* beauty in this creature's ability to sustain itself despite overwhelming odds—and in its capacity to shelter an entire community of vertebrate and invertebrate animals.

Gopherus polyphemus is actually one of four closely related species of gopher tortoises that inhabit North America. All are adapted to life in xeric habitats with relatively warm climates. The Texas, desert, and bolson tortoises find these conditions in the American Southwest and northern Mexico. East of the Mississippi River, however, such environments are limited. Restricted chiefly to upland ridges on the Southeast's coastal plain, arid communities in this region usually develop on the deep sands of old beaches and dunes—remnants of ancient times when the seas were higher than they are today.

Aridity in these habitats results not from low rainfall but from the extremely rapid percolation of water through the sandy soil. Not surprisingly, many of the plants and animals that prosper in these "deserts" of the Southeast claim their closest ancestral ties to more western members of their species groups. Millions of years ago, when seas were lower and the landscape drier, an entire savanna biota—including ancestors of the gopher tortoise, Florida scrub jay, Florida burrowing owl, short-tailed snake, and dozens more—migrated slowly eastward across southern North America, not stopping until it reached the shores of the Atlantic. As the seas rose and the once-extensive savannas of eastern North America contracted, populations of their xeric-adapted inhabitants likewise retracted. Today, relict populations of these organisms occupy the sandy ridges of eastern Louisiana, the southern sections of Mississippi, Alabama, Georgia, and South Carolina— and much of Florida.

Of the several xeric communities inhabited by *G. polyphemus*, the "sandhills" of northern Florida and southern Georgia support the greatest population densities. Under natural conditions, these areas usually are characterized by an overstory of longleaf pine and a relatively sparse understory of mixed oaks (often turkey and bluejack oak). The ground story typically includes wiregrass, bracken fern, and runner oak. Historically, the hot wildfires of late spring and summer maintained a relatively open canopy and patchy ground cover while preventing overgrowth of the habitat by young oaks. Through their promotion of grasses, legumes, and other herbaceous plants, such frequent wildfires were critical to maintaining healthy populations of gopher tortoises and other herbivores—an thereby to maintaining the ecological integrity of the community as a whole.

In an environment that may be scorched by fire at a moment's notice, and where the ready loss of surface moisture effects great swings in ground temperature daily and seasonally, every organism needs a means of escape. For the gopher tortoise—blessed with neither wings nor long legs, with neither the physiology of an endotherm nor the aquatic retreat of many of its ectothermic cousins—the problem is potentially acute. But escape it does: it goes underground.

Equipped through evolution with highly specialized and powerful front legs, the gopher tortoise is

one of nature's most adept diggers. By raising itself on its short, stumpy hind legs and then excavating the soil ahead with its forefeet, an adult tortoise ten inches long may dig a burrow 30 feet long and ten feet deep. The width of the tunnel-like burrow is just great enough to allow the tortoise to turn around at any point. At the terminus, a slightly enlarged chamber serves as the main resting area.

Relative to the outside world, the microclimate of this subterranean dwelling is highly equable: temperatures in the terminal chamber rarely fall below 61 degrees Fahrenheit or rise above 79. For the tortoise, the burrow is a refuge not only from winter cold but also from the blistering surface temperatures of the mid-summer sand. It is a place to run to from fire and predator. It is a home from which the tortoise rarely wanders as much as 50 yards, for survival depends upon it.

But other animals also live in this sometimes hostile environment, and they too must on occasion seek shelter. For some it is a transitory necessity, and the availability of a nearby "gopher" burrow is little more than fortuitous. (For example, bobwhite quail and other small birds have been observed to evade pursuing hawks by darting into tortoise holes.) But for others, the burrow is a more regular retreat: a ready-made hideaway, air-conditioned in the summer and heated in the winter, with a host who lets guests come and go as they please, asking nothing in return.

Nearly 100 species, half of them invertebrates, make use of the lodgings. The list of occasional visitors and sometime residents includes about 40 vertebrates. Among them are: skunks, rabbits, opossums, and cotton rats; oldfield, Florida, and cotton mice; armadillos and burrowing owls; pine, indigo, and coachwhip snakes; and a diversity of frogs and toads (most notably the "gopher frog," *Rana areolata).* Tortoise fecal material (mostly cellulose and semi-digested plant matter) that accumulates in the terminal chamber provides a nutritive base for an entire community of microorganisms and scavenging invertebrates. As early as 1939, a list of 32 species of insects and arachnids that had been recorded from gopher tortoise burrows. Some use burrows irregularly, while others require them during specific life stages. Still others are rarely if ever found elsewhere. The intimacy of the relationship is underscored by their names: *Copris gopheri, Onthophagus polyphemi, Philonthus gopheri.*

The diversity of and ecological relationships among the burrow fauna have only begun to be explored, yet dramatic evidence of the importance of the tortoise to its commensals is already available. The eastern indigo snake *(Drymarchon corais couperi)* is well known to residents of the Southeast. With some individuals reaching lengths of eight feet, the indigo snake is one of the largest and most spectacular colubrid snakes in the New World. Despite its size, however, the species is rather poor at retaining body moisture. An indigo snake kept under dry conditions too long may desiccate and die. Not surprisingly, this diurnal species occupies low, wet habitats throughout most of its range (including south Florida and Central and South America). In the northern half of Florida and southern half of Georgia, however, the eastern indigo snake is a prominent component of the xeric sandhill fauna. Its survival in this dry habitat is almost wholly dependent on the retreat (not only to escape desiccation but also winter cold) offered by the gopher tortoise burrow. During their recent studies of the distribution of indigo snakes in Georgia, Joan Diemer and Dan Speake of Auburn University found that 98 percent of winter sightings of indigo snakes were in sandhill habitat, and of these, 80 percent occurred within or at the entrance to a gopher tortoise burrow.

Equally impressive statistics for *Podomys floridanus,* the Florida mouse, are now being generated by John Eisenberg of the Florida State Museum. A ground dweller endemic to the xeric communities of the Florida peninsula, the Florida mouse commonly uses the burrow of a gopher tortoise as an entrance to its own—which it digs as a side passage. Eisenberg's ongoing studies have revealed population densities of Florida mice several times higher in areas with active tortoise colonies than in otherwise comparable habitats that lack the reptile. Even as you read this, zoologists throughout the Southeast are listening for the beeps of tiny radios carried by tortoise-burrow denizens; others, with specially designed remote-viewing television equipment, are observing life inside the burrow.

Even if it were not a keystone species for a whole community of animals, the gopher tortoise would fascinate herpetologists. It is one of the few reptiles that live in colonies (in this case, burrows are loosely "clumped" within a stretch of habitat) and maintain some kind of social order—a male-dominance hierarchy that presumably relates to reproductive success. Males visit female burrows and bob their heads at the entrance to draw out a mate. If two males encounter one another in the process, one is likely to be rammed or flipped out of the running.

Like many tortoises, the gopher is among the longest-lived vertebrate species and correspondingly one of the slowest to mature. According to studies conducted in southwestern Georgia by wildlife biologist J. Larry Landers and his colleagues, a hatchling tortoise must avoid the pitfalls of life for 16 to 21 years before it has its first fruitful sexual relationship. And even then, because nests are highly vulnerable to predators, the average female may produce a successful clutch of eggs only once in each decade

(Continued on page 26)

of her remaining life. Clearly, it is a lifestyle that demands high survivorship of adults.

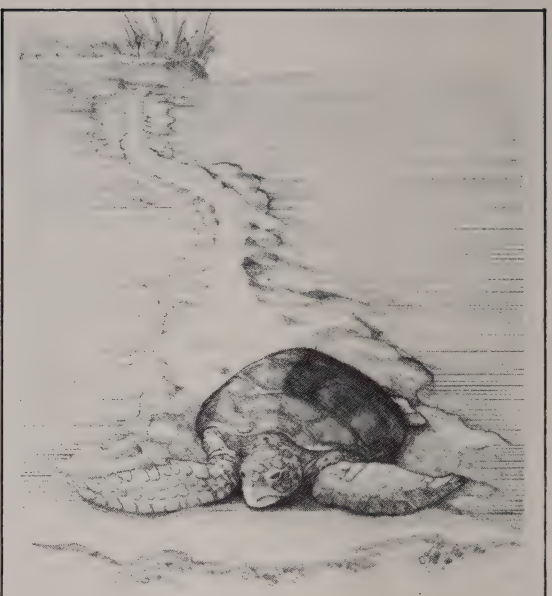
The sad fact is that bit by bit, acre by acre, the dry ridges favored by the tortoises have become orange groves, pulpwood monocultures, "improved" pastures, open-pit mines, and urban developments. And even as the population as a whole has declined with the loss and fragmentation of its habitat, the remaining individuals have been pulled unremittingly from their burrows to satisfy the human palate or sense of "sport" (racing gopher tortoises is a popular pastime).

Walter Auffenberg and Richard Franz of the Florida State Museum surveyed potential tortoise habitat throughout the Southeast from 1973 to 1975. They found the gopher tortoise population already reduced to a few critically small colonies in Louisiana and South Carolina, while in Mississippi and Alabama, remaining colonies were widely separated and seriously depleted. They also noted the portents of similar declines in Georgia and Florida—the last "strongholds" of the species. Their conclusions: 80 percent of the original population had already been lost in the last century, and few or no colonies would remain outside protected areas by the year 2025.

In response to the multiple threats to the species, its habitats, and its burrow associates, a group of scientists and concerned citizens united in 1978 to form the Gopher Tortoise Council. Through its efforts, the tortoise has been declared a protected species in some states. And The Nature Conservancy itself has already protected 14 areas for the species (12 in Florida, one in Mississippi, one in South Carolina) and is working to save more.

Like the eastern indigo snake before it, the gopher tortoise is being considered for federal listing as a threatened species in part of its range. And so are the Florida mouse, the burrowing owl, the gopher frog, the pine snake, and a burrow-full of arthropods—for we now realize that the current status and future survival of a wealth of vertebrate and invertebrate species, many already recognized as rare, are inextricably linked to the fate of their beleaguered host.

With permission of the editors, this article was adapted from "The Perfect Host" in the February 1985 issue of ENFO, published by the Florida Conservation Foundation. For further information on gopher tortoises, contact: Ellen Nicol, Gopher Tortoise Council, Route 1, Box 1367, Anthony, Florida 32617.



FLORIDA'S SEA TURTLES

Blowing Rocks, 113 acres of Atlantic beach, tropical hammock, and coastal strand vegetation, supports one of the highest marine turtle nest densities in the U.S. All four of Florida's sea turtles (green, leatherback, loggerhead, and hawksbill) nest at the preserve. The loggerhead turtle *(Caretta caretta)* nests there by the hundreds. Because these 250-pound reptiles are threatened throughout their ranges, protection of important nesting sites such as Blowing Rocks is of utmost importance.

Blowing Rocks receives more visitors—30,000 per year—than any other Conservancy preserve. Funds for long-term management are vital since the preserve is one of our most expensive to maintain. To ensure the continued protection of the preserve and its sea turtles, Florida Power and Light Company has generously donated 500 sets of limited edition prints to the Conservancy. Donors of $50 or more will receive a set of four signed and numbered prints—one each of the four sea turtles—with proceeds going toward the long-term management of Blowing Rocks Preserve.

Laura Sartucci, a Miami illustrator, created the portfolio of four sea turtle drawings for the 10-by-12-inch prints. The entire edition of Ms. Sartucci's prints contains only 500 sets; each is available solely to supporters of the Blowing Rocks Preserve. Please make your tax-deductible donation of $50 or more payable to The Nature Conservancy and send it to: The Nature Conservancy, Sea Turtle Prints, 1331 Palmetto Ave., Winter Park, FL 32789.

NEW PROJECTS

ALABAMA

Chitwood Bog (Dekalb County). Noteworthy for its thriving colony of green pitcher plants, federally listed as endangered, this small seepage bog is a new Conservancy project. Purchase of 53 acres safeguards the site, identified some years ago in the federal "recovery plan" for the plant. Chitwood is slated for management under lease to the U.S. Fish and Wildlife Service.

ARKANSAS

Marble Falls Cave (Marion County). Restricted in range to the Ozark Mountains of Arkansas and Oklahoma (and possibly Missouri), the Ozark big-eared bat is a nationally endangered mammal whose total numbers have been estimated at under 800. With the purchase of 200 acres, the Conservancy has secured the entrance to a hibernaculum for the species. Marble Falls, which was conveyed to the Arkansas Natural Heritage Commission for management, is the second of Arkansas's three known Ozark big-eared bat caves to win protection from the Arkansas Field Office (Blue Heaven Cave was secured in 1984).

GEORGIA

Marshall Forest—Additions—(Floyd County). Fronting a wild stretch of the Coosa River, this premier natural area protects a 100-acre pine/oak wood that may be the last virgin forest in the Ridge and Valley Province (a region extending from Pennsylvania to Alabama). Georgia's first national natural landmark, the sanctuary was created in 1976 through a gift from the late MacLean Marshall. Three additions totaling 71 acres bring Conservancy holdings to 291 acres. An innovative braille trail runs through the site, which is managed by a Conservancy preserve committee with help from students and faculty at Shorter College and other local schools.

ILLINOIS

Round Pond Preserve (Pope County). Conservancy purchase of 180 acres in three tracts protects an unusual bald cypress swamp in southern Illinois. "Perched" on an old terrace of a preglacial lakebed, Round Pond is believed to be much older than other cypress swamps in the region. The site supports *Carex alata,* a sedge listed as endangered in the state, as well as *Hottonia inflata,* an unusual native aquatic plant. The Illinois Chapter manages the new preserve.

INDIANA

Hall Woods (Putnam County). This 54-acre tract of nearly level hilltops and deep ravines is a gift of the Ruth Hall family. The area's highlight is a mixed mesophytic forest community, judged by the state's Division of Nature Preserves to constitute 10 to 15 percent of the state's high-quality white oak woods. The site will be managed by the Indiana Chapter and the state's Department of Natural Resources.

Lookout Point Gravel Hill Prairie (Tippecanoe County). Thanks to a generous gift of land from Watland Farms, Inc., the Conservancy has saved the third of Indiana's three known gravel hill prairies, a fragile and highly jeopardized natural community. Topping a steep slope above Wea Creek and the Wabash River Valley, the new 15-acre Indiana Chapter preserve hosts 12 plants listed for protection in the state, including five judged to be endangered: slender sandwort, oblong leaf aster, western wallflower, fringed puccoon, and prairie satin grass. Lookout Point is a project of the Conservancy/state Indiana Natural Heritage Protection Campaign.

Olin Lake Nature Preserve—Addition—(LaGrange County). A final 64-acre purchase clinches protection for the largest undeveloped lakeshore in Indiana. Olin's waters support the cisco *(Coregonus artedii),* a fish ranked as endangered in the state. Moreover, the 190-acre preserve bears two plants threatened in Indiana: early lady's tresses *(Spiranthes lucida)* and alder buckthorn *(Rhamnus alnifolius).* The addition will be transferred to the Indiana Department of Natural Resources for management by its Division of Nature Preserves.

IOWA

Cedar Hills Sand Prairie (Black Hawk County). It's a relict sand prairie—one of Iowa's last—a rolling landscape with seeps, marshes, and a swale that supports sphagnum moss. The recently purchased 35-acre sanctuary, whose roster of 280 plant species includes the only recorded occurrence of the sedge *Carex leptalea*

Geoff Pampush

Round Top Butte

Grand views of Mount McLoughlin would be enough to shoot Round Top Butte to the top of any conservationist's dream list—but ecological values surpass even the scenic here. It is one of Oregon's last expanses of native grassland (a bluebunch wheatgrass/Idaho fescue/Lemmon's needlegrass community) and oak savanna (with Oregon white oak, California black oak, and madrone) And the area's healthy population of pygmy monkey-flowers *(Mimulus pygmaeus),* a species under consideration for federal protection, qualifies it as a project of the Conservancy's highly successful Katharine Ordway Endangered Species Conservation Program.

Thanks to a partial gift of land from Timber Products, Inc., the Oregon Chapter has gained an 80-acre anchor parcel here. When complete, protection will span some 760 acres, including an exceptional Bureau of Land Management "research natural area." Yet another triumph of the Conservancy's long campaign to save the Northwest's grasslands, Round Top is a fine example of cooperation between the private and public sectors.

in Iowa, will be managed by the University of Northern Iowa's botany department.

Hoffman Prairie and Marsh Preserve (Cerro Gordo County). Riding a low, rolling moraine, this wet-to-mesic blacksoil prairie (rare in Iowa) is enriched by a complex of sloughs, prairie marshes, and sedge meadows. The 36-acre preserve provides significant habitat for three butterflies considered rare or threatened in the state: sedge skipper, broad-winged skipper, and Poweshiek skipperling. Two state-listed plants—the endangered cotton-sedge *(Eriophorum angustifolium)* and the threatened grass-of-parnassus *(Parnassia glauca)*— occur here as well. The Iowa Chapter manages the area in concert with the Cerro Gordo Conservation Board and the Iowa Conservation Commission.

OHIO

Big Darby Creek Preserve (Pickaway County). This 80-mile watercourse is the most biologically diverse stream in Ohio. It has to its credit the world's only occurrence of the Scioto madtom (a nationally endangered fish) and an abundance of northern riffle shells (a mollusk currently under consideration for federal listing). Big Darby is known for its outstanding water quality—critical to throngs of fish (90 species), mollusks (40 species), waterfowl, and mammals—and the uncommon plant communities that line its banks. Conservancy purchase of 55 acres safeguards a corridor of riparian vegetation along a critical reach of the creek. The Ohio Chapter preserve takes in Commercial Point Riffles, habitat for several mollusks of national significance and three fish listed as endangered in the state.

Flatiron Bog (Portage County). Bearing a striking resemblance to the boreal forest bogs of Canada 300 miles north, Flatiron is one of Ohio's finest acid bogs—with at least 15 rare plants and two communities considered endangered in the state. A recent 70-acre purchase encompasses one of these communities, a tamarack hardwood bog, and establishes an anchor holding for the Ohio Chapter. The projected preserve will include all of the area's vegetation zones—from upland oak forest to the highly acidic pool at the bog's heart. The Ohio Field Office will manage the area.

RHODE ISLAND

Dickens/Lewis Farm—Addition—(Washington County). Ten miles off the Rhode Island coast, picturesque Block Island is a refuge for rare birds—peregrine falcons, bald eagles, northern harriers, upland sandpipers, and grasshopper sparrows among them. Its southwest corner, a grassland expanse with freshwater kettle ponds, is a priority of the Conservancy's National Wetlands Conservation Project. Extending the 200-acre preserve eastward to Rodman's Hollow, this 37-acre addition was a partial gift of William Lewis and a partial purchase with the generous support of the Kresge Foundation.

Rodman's Hollow (Washington County). Adjoining the Dickens/Lewis Farm on its eastern border, this 114-acre acquisition provides nesting habitat for the rare northern harrier and hunting grounds for such migrant raptors as bald eagles and peregrine falcons. Nationally significant bushy rockrose occurs here in its most abundant Rhode Island population. The Massachusetts/Rhode Island Field Office has $75,000 yet to raise to complete the $450,000 private funding share of this co-op project with the Town of New Shoreham and the state.

TENNESSEE

Tennessee River Gorge—Additions—(Hamilton and Marion Counties). Cooperative management agreements with the owners of three tracts totaling 4,260 acres enhance Conservancy protection for a critical portion of this 25,000-acre gorge. The area is renowned for its host of uncommon plant communities and rare species (including osprey and bald eagles—and a plant under review for federal protection, *Scutellaria montana).* Now 14,525 acres all told, the preserve is monitored by the Conservancy's Tennessee River Gorge project director.

Vesta Coneflower Preserve (Wilson County). Lodged in a cedar glade in the middle of the state, this 90-acre property boasts a healthy and abundant population of Tennessee coneflowers *(Echinacea tennesseensis)*—a federally listed endangered species known from only five sites in the world. Identified by the state's natural heritage program, the site was purchased for transfer to the Tennessee Department of Conservation. It will be managed as a new state natural area.

VERMONT

Long Pond—Addition—(Orleans County). One of fewer than a dozen undeveloped lakes in Vermont, Long Pond and its environs are alive with moose, bobcats, foxes, otters, bears, fishers, and loons. Having received a 99-year management lease on 32 acres at the lake's southern end from Clive S. Gray last year, the Conservancy has acquired an additional 40 acres—including an 11-acre gift from Mansfield Freeman. The Barr Hill Stewardship Committee manages the sanctuary.

VIRGINIA

Blackwater Ecologic Preserve (Isle of Wight County). A 318-acre gift of land from Union Camp Corporation spells preservation for Virginia's finest southern pine barrens, a natural community that once claimed 150,000 acres in the state. Rooted in white sands deposited eons ago (when sea level was 70 feet higher than it is today), the system abounds in plants rare to Virginia, including *Polygonella polygama, Seymeria cassioides,* and *Pyxidanthera barbulata.* Blackwater—one of the state's ten most significant biological areas according to the Virginia Natural Diversity Information Program—was protected through the Conservancy's ambitious Conserve Virginia Campaign. It has been conveyed to Old Dominion University and will be managed jointly by its biological sciences department and the Virginia Chapter.

FIELD COURSES OFFERED AT SYCAN MARSH

From May to July 1986, ten-day field courses embracing ornithology, botony, and regional land use will again be offered at Katharine Ordway Sycan Marsh, a 25,000-acre Conservancy preserve along the interface of Oregon's Cascade Range and the Great Basin. Excursions will take in alkaline lakes and fault-block mountains, sage deserts, Crater Lake National Park, and mountain forests and marshes.

Transportation, meals, tents, and a cabin are provided for nine participants at a beautiful spring-side campsite. Cost is $850 per ten-day session. For further information, contact: Sycan Program, The Nature Conservancy, 1234 N.W. 25th Ave., Portland, OR 97210. Phone: (503) 228-9561.

OHIO CHAPTER SPONSORS FLORIDA TRIP

The Ohio Chapter invites Conservancy members to participate in an early spring naturalist adventure to south Georgia and Florida. The March 1986 tour will visit a variety of nature preserves, refuges, and other off-the-beaten-path wonders of Florida's natural history. Included in the itinerary are Okefenokee Swamp, the Everglades, Corkscrew Swamp, Ocala National Forest, and many stops in between. Travel in Florida will be on a deluxe motor coach, an occasional boat, and along paths, a boardwalk, and beaches. For details contact Bixler Tours, Box 37, Hiram, Ohio 44234.

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